Ocean Liner Shipping: Organizational and Contractual Response by Agribusiness Shippers to Regulatory Change

Hayden G. Stewart
Economic Research Service, U.S. Department of Agriculture, Room N-2134, 1800 M Street NW, Washington, DC 20036. E-mail: hstewart@ers.usda.gov

Fred S. Inaba
Department of Economics, Washington State University, Pullman, Washington 99164–4750. E-mail: inaba@wsu.edu

ABSTRACT

The Ocean Shipping Reform Act of 1998 (OSRA) promotes changes in international ocean liner shipping. An important policy issue attendant to the passage of OSRA is the Act's likely impact on the international competitiveness of the sectors that depend upon ocean shipping. Thus, to establish how freight rates and other logistical costs of using ocean liner services are now determined, this study examines emerging methods of organization and contracting among exporters of food and forest products. We find that, although many shippers negotiate private contracts with carriers, many others utilize a third-party agent to negotiate a rate with a carrier on their behalf. This article also identifies differences between two key types of third-party agents. Finally, given that a shipper in this trade does not contract directly with a carrier, this article explains the shipper's conditional choice about which type of agent to use. [EconLit citations: L140, L980, Q130]. © 2003 Wiley Periodicals, Inc.

1. INTRODUCTION

The Ocean Shipping Reform Act of 1998 (OSRA), PL#105–258,[1] promotes changes in international ocean liner shipping[2] with implications for how exporters and importers of containerized cargo (shippers) contract with the operators of containerships (carriers). An important policy issue attendant to the passage of OSRA is the Act's likely impact on the international competitiveness of the sectors that depend upon ocean shipping. Specifically, how are ocean freight rates and other logistical costs of using ocean liner services

---

[1]OSRA became a law in October 1998, and was implemented in May 1999. Some insiders consider OSRA a "deregulation," while others consider it a "reregulation." These latter commentators wish to emphasize that a significant number of regulatory controls still exist.

[2]The focus of this legislation is the international ocean liner shipping industry in the United States foreign trade, which encompasses the transport of goods by container between the United States and its overseas trading partners. It does not include other ocean transportation industries such as wet and dry bulk shipping, which are how commodities such as oil, grains, and logs are generally transported.

likely to be determined under the new OSRA regime? This article answers this question by focusing on a particular group of agribusiness shippers. We investigate how, in the post-OSRA era, these shippers are looking for new ways to transact with carriers. We also identify the relative costs and benefits of available options. This group of shippers includes exporters of food and forest products from the U.S. West Coast to East Asia.

OSRA reformed the previous regulatory regime in which the Federal Maritime Commission (FMC)[3] enforced "common carriage." Under this prior system, as outlined in the Shipping Act of 1984, shippers could either utilize a carrier's published schedule of tariff rates or negotiate direct time/volume (service) contracts. In both cases, the FMC collected data on critical aspects of the transaction, made this information publicly available, and required the carrier to offer the same terms to any "similarly situated" shipper. Consider the following illustrative example. If one shipper of frozen cut potatoes had negotiated a service contract, another shipper of frozen cut potatoes could look up the rate and other conditions of this contract. The second shipper could then demand the same terms. If the two shippers were contracting for a similar volume and using the same lane, the carrier(s) were obliged to grant the second shipper's request. Such service contracts were known as "me-too" contracts.

The lack of confidentiality and the "me-too" stipulations of bilateral service contracts between carriers and shippers tended to tilt market power towards rate-setting cartels, called conferences. As a result, conferences gained control over the majority of containerized trade between the United States and East Asia. In the years prior to OSRA's passage, two conferences dominated traffic: the Transpacific Westbound Rate Agreement (TWRA) oversaw exports, and the Asia North America Eastbound Rate Agreement (Anera) oversaw imports.

OSRA promotes a more market-driven environment for the determination of ocean freight rates based on private contracting between shippers and carriers. Common carriage no longer applies to freight rates in service contracts. It only applies to the schedules of tariff rates that carriers are still required to make publicly available. Since the implementation of OSRA, carriers and shippers have been taking advantage of the confidentiality of service contracts. The FMC estimates that contracting is up 200%, and 80% or more of all cargo now moves under private contract on major trade lanes (Federal Maritime Commission, 2001).

We conclude that the provisions of OSRA have weakened the rate-setting power of cartels, while increasing the options available to shippers for transacting with carriers. The options that shippers choose depend upon shipper characteristics. In particular, shippers of larger volume lots are more likely to negotiate service contracts directly with carriers. Such contracts allow them to obtain lower prices and more tailored service than tariffs. By contrast, smaller shippers are more likely to take advantage of emerging organizational forms that rely on third-party agents to aggregate the individual lots of shippers for the sake of negotiating lower freight rates. Moreover, a shipper's choice among these organizational forms is influenced by product heterogeneity, and shippers may incur costs in addition to the freight rate when utilizing third-party agents.

2. THE DATA

This article examines how agribusiness firms are responding to the new regulatory environment of OSRA. These responses were identified in interviews with shippers, shippers'

---

[3]The FMC regulates ocean liner shipping in the U.S. foreign trade; regulations listed here applied to all goods except a small number of exempt commodities, mostly forest products.

agents, and carriers. The authors also conducted a survey of firms exporting from the United States to East Asia via West Coast Ports. Sampled firms included shippers of dimension lumber, engineered wood products, fresh produce, beef, poultry, food ingredients, juice purees and concentrates, canned foods, dried foods, nuts, and other foods. For the survey, the authors and an undergraduate research assistant contacted 89 firms of which 81 firms were successfully sampled.[4] Thus, the response rate exceeded 90%.[5]

The survey was conducted by telephone, and the interviewer requested a manager who was responsible for handling transportation to East Asia. The respondent was then questioned about the company as well as its organizational and contractual decisions. Collected data included the type of commodity shipped, the shipper's total volume of cargo, the regularity of the shipper's lots, whether the shipper relied on a third-party agent for leverage in negotiations, and the type of third-party agent (if any) used.

The authors classified shippers by product category, annual volume, and regularity of their lots.[6] As for volume, shippers were classified as "small" if they annually exported between 1 and 100 20-foot equivalent units (TEU), "medium" for between 101 and 1000 TEU, "large" for between 1,001 and 5,000 TEU, and "very large" for more than 5,000 TEU. Small shippers were further classified as "regular" or "irregular" according to whether they could make binding commitments to export a positive number of TEU over the upcoming year. The inability to make such a commitment can prevent small exporters from entering a shippers' association or negotiating service contracts. Such shippers are colloquially known as "spot shippers."

3. INTERNATIONAL OCEAN LINER SHIPPING

Under the Shipping Act of 1984, the FMC permitted cartels.[7] However, it also required these cartels to remain open[8] and mandated that members be allowed to take "independent action" on published tariff rates.[9] Furthermore, as mentioned previously, the FMC enforced common carriage. Conferences and individual carriers had to file their rates for serving the general public as well as the conditions of their service contracts. The FMC then required that "similarly situated" shippers be offered the same rates.

[4]A list of firms to survey was generated from two different sources. First, we identified producer associations that include companies supplying food and forest products. Many of these associations have home pages on the Internet with a list of their members. Others were contacted for a list of members. Second, we obtained a list of firms who had attended a trade show in Japan for food products, FOODEX 1999. This sampling procedure had the advantage that most firms could be compared by their Web sites. Nonrespondents could then be compared with respondents to ensure against any response bias. Indeed, no such bias was detected.

[5]Nonrespondents include companies at which the appropriate person could not be located, the appropriate person was "too busy" to answer the questions, and one firm that regarded the material as proprietary.

[6]It was not possible to treat volume and regularity as continuous variables because many shippers were either unsure of their exact shipping requirements or regarded exact figures as proprietary information. However, all shippers who answered the survey could readily specify into which of the authors' specified categories they belonged.

[7]Conferences in the United States foreign trade were first recognized and provided with immunity from antitrust in the 1916 Shipping Act. The conditions attached to their immunity have varied over the years.

[8]Most conferences operating outside of the United States foreign trade are "closed," meaning that they may prevent other carriers from joining the conference. However, carriers in the United States foreign trade must remain "open" to new entrants.

[9]Members of conferences had the right to take "independent action" with regard to the freight rates they offer. In other words, they could charge rates other than the conference rate if they provide advanced notice. However, this right did not extend to service contracts.

Conferences were effective rate-setting institutions as long as members limited their use of independent actions and independent carriers presented little in the way of competition. According to the "folk theorem" of repeated games (e.g., Fudenberg & Tirole, 1993), conference members were unlikely to deviate from agreed upon rates. Regulations requiring the public disclosure of rates facilitated the ability of cartels to monitor their members. In turn, members realized that deviating would lead to a breakdown of collusion, while the "me-too" provision further limited the benefits from cheating on cartel rates. Thus, these regulations helped conferences to operate effectively as rate-setting institutions, thereby explaining the findings of Fox (1994), that carriers acted "as a cartel to determine price jointly and then set their own quality levels to maximize individual profits."

The ability of independent carriers to take freight away from conference members was limited by service differentials even though independents tended to charge rates below what conference carriers offered. For instance, the Food Shippers Association of North America (FSANA), having been refused a contract with the TWRA, signed service contracts with independent lines. However, to obtain the services of a conference carrier, FSANA-affiliated shippers would often pay the TWRA's published tariff rates. Although conferences tended to set rates, their power to charge monopoly prices was constrained by their inability to prevent independent actions and to limit entry. Clyde and Reitzes (1998) found that conferences had little market power during the years 1985 and 1988.

Problems for conferences mounted as the quality of service provided by independent lines improved over the 1990s. Neel and Gooding (1997) examine how independent lines began to successfully take business away from conference carriers and how conference carriers responded by behaving more like independents. Conference carriers were found to be negotiating service contracts with large shippers without the prior approval of the conference to obtain additional business.

4. OSRA AND SERVICE CONTRACTS

OSRA promotes a more market-driven environment for determining freight rates based on private contracting between carriers and shippers. It removes the "me-too" provision from service contracts and makes information on freight rates contained within service contracts confidential. Indeed, as mentioned previously, carriers and shippers have increased their use of service contracts since the passage of the Act.

The power of cartels over rates has diminished as service contracting has increased. In fact, both the TWRA and Anera have ceased operations. This result was expected. TWRA spokespeople reported in the summer of 1998 that OSRA threatened their future as a rate-setting institution[10] It was foreseen that collusive agreements would be unable to monitor the activities of members in the new business environment.

Many economists believe that collusion is likely to continue even as many conferences disband. Neel, Gooding, and Padgett (1996) survey these arguments. In fact, at this time, collusion continues on the Pacific in the form of "discussion agreements." The Westbound Transpacific Stabilization Agreement (WTSA) is overseeing exports to Asia and the Transpacific Stabilization Agreement (TSA) is overseeing imports. The ultimate role of these discussion agreements remains unclear. According to the executive director of

---

[10]TWRA. Personal interview, 20 Aug 1998.

TABLE 1.   Fraction of Shippers
Negotiating Directly with Carriers

Category	Fraction
Small	21%
Medium-sized	48%
Large	71%
Very Large	100%

the TSA, discussion groups collect data on cargo volumes, capacity utilization, and equipment requirements. They also discuss rates, although all guidelines are voluntary.

Carriers are not only willing to draft individualized service contracts, but it appears that shippers can obtain volume discounts on these contracts. The authors asked a small number of shippers about the discount that they receive over published tariff rates. Small- and medium-sized shippers reported an average discount of 12.5%, whereas large and very large shippers reported a mean discount of 25.75%.[11] We argue that these discounts reflect a strategy by carriers to secure business with shippers requiring recurrent service for large-volume lots. Indeed, the unit costs of serving such shippers are likely to be lower because costs for such things as billing, administration, and contracting need not be replicated for each container. Table 1 suggests that shippers of larger volume lots tend to contract directly with carriers.

5. THIRD PARTY AGENTS

Shippers not contracting directly with a carrier may rely on a third party to negotiate their freight rate. These third-party agents consolidate the freight of numerous individual shippers. In turn, they can obtain volume discounts. However, it is not sufficient for third-party agents to internalize transactions costs; rather, shippers must create a genuine efficiency gain when they consolidate their individual lots. The resulting surplus can then be redistributed among the consolidating shippers.

Policymakers are also aware of the increasing importance of third-party agents to small shippers under OSRA. Says the Program Manager of Shipper and Exporter Assistance at the United States Department of Agriculture (USDA), "We at the United States Department of Agriculture are very concerned how small and medium sized shippers will be effected by all of the new rules and regulations . . . We will conduct seminars and perform research to see the changes that deregulation brings . . . The areas that we will look at are the use of shippers' associations, freight forwarders, price discrimination, and the bargaining powers of small shippers compared to that of larger ones."

Third-party agents serving shippers of food and food forest products include freight forwarders and shippers' associations. Key differences exist between them and shipper characteristics appear to determine a shipper's choice among them (Table 2). Of the 43 respondents in the sample who rely on a third-party agent, 22 joined a shippers' association and 21 aligned with a freight forwarder.

---

[11]Data for these statistics was collected during interviews with nine shippers and agents who negotiate service contracts with carriers. Due to the confidentiality of service contract rates, agents were asked for the approximate discount that they receive over the published tariff rate. The mid-point was used if the interviewee replied with a range for their discount, for example, 10 to 15% was recorded as 12.5%.

TABLE 2.   Conditional Fraction of Shippers Choosing an Association

Size	
Small	36%
Medium-sized	56%
Large	100%
Regularity	
Regular	63%
Irregular Lots	23%
Product	
Lumber and engineered wood products	57%
Meats and poultry	60%
Fresh fruits and vegetables	75%
Processed foods and/or multiple types of food products	20%

The role of a freight forwarder is similar to the responsibilities of a travel agent in the movement of tourists. A freight forwarder does not take control of a consignment; rather, it handles only logistical matters. These matters include booking space with a carrier, obtaining export clearance, arranging for products to be containerized, completing export documentation, arranging for cargo insurance, advising on foreign import regulations, and providing guidance on packaging, marking, and labeling.[12]

The freight forwarder does not sign a contract directly with a carrier. The shipper is the final signatory to any contract. It is therefore not surprising that contracts negotiated by a freight forwarder are generally not large volume contracts. Nonetheless, a freight forwarder may obtain leverage vis-à-vis carriers based on the cumulative volume of contracts negotiated.

There are also costs to utilizing a freight forwarder. Freight forwarders charge their clients an agreed-upon amount, documentation charges, and a small percent of the ocean freight rate currently around 1.25%. Thus, transportation fees will increase in the shipper's size by at least 1.25% per container regardless of the number of containers handled.

Shippers choosing a freight forwarder may also incur agency costs. The shipper (principal) wants the freight forwarder (agent) to extend a maximal effort in negotiating a freight rate. However, the freight forwarder may benefit from "shirking" or profit from higher fees collected. This problem may be compounded by a shipper's inability to exactly monitor the behavior of their agents. First, if the shipper has only limited information about freight rates, it cannot monitor the freight forwarder's performance exactly. Second, the freight forwarder provides a wide range of services and may pass along higher freight rates by bundling freight rate negotiation and high-quality assistance with other logistical matters.[13]

Shippers' associations can be viewed as a private good club. As argued by McGuire (1972) and Sorenson, Tschirhart, and Whinston (1978), in the presence of economies-of-scale, private good clubs may form to collectively make purchases. In ocean transporta-

[12]In addition to personal interviews, information on freight forwarders was obtained from the Agricultural Marketing Service of the U.S. Department of Agriculture.

[13]Some shippers were concerned about the agency problem. These shippers felt that they could obtain better rates on their own. Such shippers argued that they would work harder at negotiating a rate for themselves than a freight forwarder would work for them.

tion, shippers pool their cargo and collectively negotiate contracts with carriers. Associations then sign all contracts and individual members utilize these collective contracts.[14]

Different shippers' associations provide different ranges of service. In addition to freight rate negotiation, some associations also take possession of their member's cargo and provide a complete menu of logistical support. Such associations may even have arrangements with providers of intermodal transportation to provide door-to-door service. However, membership in such an association does not oblige the shipper to utilize her cooperative's logistical support. A member may utilize one of the association's contracts but hire an outside freight forwarder to handle other matters.

A second type of association only negotiates freight rates. PNASA and FSANA are such cooperatives. According to association managers, members must use an outside freight forwarder for help with other logistical services.

Shippers' associations can recover their costs in a few ways. The authors interviewed several associations who charge each member a uniform administrative fee. It follows that smaller shippers pay a higher unit fee for membership than larger shippers. The larger shipper can spread this fee over more units than the smaller shipper can. The authors also interviewed one association that charges members a rate of between $10 and $99 per container handled. Once again, smaller shippers pay a higher fee.

The pricing strategy of shippers' associations can be explained by discrepancies in what members contribute to an association. Sorenson et al. (1978) show that members of a private good club might receive their Shapley Value. The Shapley Value assigns to each member a share of the rents that is proportional to the member's contribution. In international ocean liner shipping, larger shippers generate a disproportionate share of the efficiency gains. In turn, they are rewarded with an equally larger share of the rents.

Shippers incur other costs for joining an association in addition to paying a membership fee. These costs can be generated when the shipper coordinates its shipments with the shipments of other coalition members. Says one exporter of forest products in the Pacific Northwest, "There are advantages to being independent." Some anecdotal evidence of these costs was collected in interviews with shippers. For instance, one exporter of food ingredients who annually ships between 1,000 and 1,500 TEU once considered joining an association. The association's rates were comparable to the rates independently obtained. However, the firm was skeptical of the quality of service provided by the set of carriers with whom the association was contracting. The timeliness and accuracy with which a carrier processes paperwork is a major issue for shippers. Similarly, an exporter of fruit purees and concentrates reports that joining an association could be problematic. This firm describes itself as a medium-sized shipper, and it currently has long-standing relationships with a few carriers. Furthermore, the shipper claims that it can negotiate discounted rates to all ports to which it requires service. By contrast, the firm has not identified any shippers' association with contracts to all ports to which the company requires service. Thus, the firm worries that severing direct ties with carriers might lead to lower rates on some lanes but higher rates on other lanes.

Shippers of heterogeneous goods may have the highest costs for joining an association to the extent that they also have the most variable shipping requirements. For instance, if shippers of a relatively homogeneous commodity (e.g., fresh fruits and vegetables) have similar transportation requirements, they can probably coordinate their shipments more

---

[14]In addition to personal interviews, information on shippers' associations was obtained from the Agricultural Marketing Service and the American Institute for Shippers' Associations (2001).

easily than exporters of heterogeneous foods. Lower costs for coordination among the shippers of the homogeneous commodity then translate into a larger efficiency gain for these shippers.

6. THE MODEL

The above analysis suggests several hypotheses that can be tested with an economic and statistical model of a shipper's decision-making process. Thus, we propose below such models in which a shipper decides whether to negotiate directly with a carrier or seek the assistance of one of the available types of third-party agent. Shippers of smaller volume lots are hypothesized to utilize third-party agents to obtain discounted freight rates otherwise offered to larger shippers. However, a shipper's choice between a freight forwarder and a shipper's association is also hypothesized to depend upon the type of good being handled and other characteristics of the shipper.

In specifying an economic model of a shipper's organizational and contractual decisions, the authors had to specify whether shippers make decisions sequentially or simultaneously. In the former case, a shipper's decision tree would consist of two binary choices (Fig. 1). At the first node, a shipper would decide whether to rely on its own leverage (OWN) or to align with a third-party agent (TPA). At the second node, if the shipper had selected TPA, this shipper would next choose between a freight forwarder (FF) and a shippers' association (SA). By contrast, in an economic model based on simultaneous decision making, shippers would make only one decision among OWN, SA, and FF. However, because it ignores the fact that two out of three choices both involve a TPA, this later model may be less efficient.

The authors decided to develop statistical models corresponding to both of the above economic models, a two-stage binary choice model and a multinomial logit model. We obtained similar results with both models in terms of the impact of key variables and the statistical significance of these impacts. We present below the derivation of the model for a sequential decision-making process.

The derivation of a formal economic model corresponding to Figure 1 begins by examining a shipper's decision at the second node. It is assumed that a shipper selects SA or FF to maximize profits. Thus, the shipper's decision problem can be written as

$$\text{Prob}[Y_{2i} = 1] = \text{Prob}[\Pi^{SA} > \Pi^{FF}] \text{ for } i = 1, \ldots, N \text{ shippers}$$

where Π^{SA} and Π^{FF} represent i's profits of the two choices and the response variable, Y_2, is such that $Y_{2i} = 1$ if i selects SA and $Y_{2i} = 0$ otherwise.
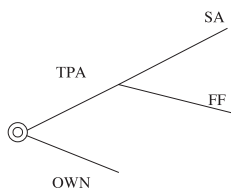

Figure 1   Model of a sequential decision-making process.

It is assumed that the profits of the two choices are linear:

$$\Pi^{SA} = \beta'_{SA}X + \varepsilon_{SA} \text{ and } \Pi^{FF} = \beta'_{FF}X + \varepsilon_{FF}$$

where X is a vector of characteristics and the unknown parameters are β_{SA} and β_{FF}. It follows that

$$\text{Prob}[Y_{2i} = 1] = \text{Prob}[\beta'_{SA}X + \varepsilon_{SA} - \beta'_{FF}X - \varepsilon_{FF} > 0]$$

$$= \text{Prob}[(\beta'_{SA} - \beta'_{FF})'X + (\varepsilon_{SA} - \varepsilon_{FF}) > 0]$$

$$= \text{Prob}[\beta'_2X + \varepsilon_2 > 0]$$

where β_2 is a vector of unknown parameters and the random errors are ε_{SA}, ε_{FF}, and ε_2.

We have argued that a shipper's decision at the second node may depend on the shipper's contribution to an association, i.e., the shipper's Shapley Value. Because "spot" shippers contribute the least to an association, it follows that they will receive the smallest share of the rents. Thus, a dummy variable was created to indicate spot shippers, SPOT. This variable equals 1 for shippers who are both small and irregular. SPOT equals zero for all other shippers.

We have also argued that the costs of belonging to an association include the costs of cooperation. Members must coordinate their shipments with the shipments of other members, and these costs are greatest for shippers of heterogeneous goods. Thus, we use the following dummy variables to account for the homogeneity of the shippers' goods: (a) P1 = 1 iff transports only lumber and/or engineered wood products; (b) P2 = 1 iff transports only meat and/or poultry; (c) P3 = 1 iff transports only fresh produce; (d) P4 = 1 iff transports processed food products or multiple types of goods.

One of these variables, P4, was omitted from the regression to avoid collinearity.

We now work backwards and consider the first node in the economic model in which a representative shipper selects OWN or TPA to maximize profits. It follows that

$$\text{Prob}[Y_{1i} = 1] = \text{Prob}[\Pi^{TPA} > \Pi^{Own}] \text{ for } i = 1, \ldots, N \text{ shippers}$$

where Π^{TPA} and Π^{Own} represent i's profits of the two choices. The response variable, Y_1, is such that $Y_{1i} = 1$ if i selects TPA and $Y_{1i} = 0$ otherwise.

A linear random profit model is again assumed such that

$$\Pi^{TPA} = \beta'_{TPA}X + \varepsilon_{TPA} \text{ and } \Pi^{Own} = \beta'_{Own}X + \varepsilon_{Own}$$

then

$$\text{Prob}[Y_{1i} = 1] = \text{Prob}[\beta'_{TPA}X + \varepsilon_{TPA} - \beta'_{Own}X - \varepsilon_{Own} > 0]$$

$$= \text{Prob}[\beta'_{TPA} - \beta'_{Own}]'X + (\varepsilon_{TPA} - \varepsilon_{Own}) > 0]$$

$$= \text{Prob}[\beta'_1X + \varepsilon_1 > 0]$$

where β_1 is a vector of unknown parameters and the random errors are ε_{TPA}, ε_{Own}, and ε_1.

It should be clear that $\Pi^{TPA} = \max\{\Pi^{SA}, \Pi^{FF}\}$. In particular, according to the logic of sequential rationality, we assume that

$$\Pi^{TPA} = \beta'_{TPA}X + \varepsilon_{TPA} = \beta'_{SA}X + \varepsilon_{SA}$$

or

$$\Pi^{TPA} = \beta'_{TPA}X + \varepsilon_{TPA} = \beta'_{FF}X + \varepsilon_{FF}$$

depending on the shipper's decision at the second node.

We have argued that large shippers may have a superior ability to negotiate freight rates because of efficiency gains associated with shipping high volume lots. Accordingly, we include VOLUME in our model. This variable equals the midrange of shipper volumes in each category. In particular, VOLUME equals 50.5 for small shippers, 550.5 for medium-sized shippers, 3000.5 for large shippers, and 7500.5 for very large shippers.

The authors next assumed that ε_1 and ε_2 are distributed normally to formally model $P[Y_{1i} = 1]$ and $P[Y_{2i} = 1]$. It follows that

$$\text{Prob}[Y_{1i} = 1] = F(\beta_1 x_{1i}) \tag{1}$$

and

$$\text{Prob}[Y_{2i} = 1] = F(\beta_2 x_{2i}) \tag{2}$$

where F is the standard normal CDF.

Amemiya (1975) shows that (1) can be estimated from the full data set, and (2) can be estimated using only the subset of shippers who selected TPA at the first stage. In this "sequential response" model,

$$P[Y_{1i} = 1 \text{ and } Y_{2i} = 1] = F(\beta_1 x_{1i})F(\beta_2 x_{2i})$$

and

$$P[Y_{1i} = 1 \text{ and } Y_{2i} = 0] = F(\beta_1 x_{1i})[1 - F(\beta_2 x_{2i})]$$

However, Amemiya's (1975) model requires that the error terms at each node be independent, whereas our economic model states that

$$\varepsilon_2 = \varepsilon_{SA} - \varepsilon_{FF} \text{ and } \varepsilon_1 = \varepsilon_{TPA} - \varepsilon_{Own}$$

where $\varepsilon_{TPA} = \varepsilon_{SA}$ or ε_{FF}. A "shock" at the second node will carry over to the first node. A correlation near one would be expected.

Greene (1998) shows how to account for any nonzero correlation between ε_2 and ε_1. In the bivariate probit model with a correction for sample selection, a shipper's decision at the first stage is modeled as an unconditional choice. However, a shipper's decision at the second stage is modeled as

$$\text{Prob}[Y_{2i} = 1 | Y_{1i} = 1] = \frac{\Phi_2[\beta_2 x_{2i}, \beta_1 x_{1i}, \rho]}{\Phi[\beta_1 x_{1i}]}$$

where Φ_2 is the bivariate normal cumulative probability, Φ is the univariate normal cumulative probability, and the sample selectivity is significant if $\rho \neq 0$.

The estimated coefficients and standard errors are provided in Table 3. However, it should be noted that the estimated value of ρ did not remain between -1 and 1 for early iterations. The software (LIMDEP^{TM}) then reported that the estimated values may not be a solution even though the algorithm converged after 10 iterations. Indeed, the standard errors of the estimated coefficients were suspect. This problem suggests the need to consider a linear probability model for the sake of confirming our results.

The authors estimated a linear probability model using Heckman's two-stage estimator. In particular, a probit model was used to estimate (1). Generalized least squares was then used to estimate the parameters in (2), including the coefficient on the inverse Mills ratio, IMR. Finally, standard techniques were used to estimate ρ and the asymptotic covariance matrix of the coefficients (Greene, 1997).

TABLE 3.   Parameter Estimates and Standard Errors

Model	Bivariate Probit	Linear Probability
Equation for node one		
Constant	0.6054	0.6054
	(0.1952)[a]	(0.1952)[a]
Volume	−0.0004	−0.0004
	(0.0001)[a]	(0.0001)[a]
Equation for node two		
Constant	−1.1852	0.025
	(8.5×10^5)	(0.2468)
P1	1.1547	0.3597
	(0.5816)[a]	(0.2049)[b]
P2	0.8887	0.3197
	(0.5402)[b]	(0.2063)
P3	1.1451	0.373
	(0.4497)[a]	(0.1739)[a]
SPOT	−0.6032	−0.251
	(0.4497)	(0.1594)
Selectivity Correction		
ρ	0.9999	
	(1.36×10^{18})	
IMR		0.4775
		(0.3162)
Auxiliary statistics at convergence		
Number of iterations	10	
Log likelihood	−69.702	
Predicted at node one	55/81 (67.9%)	
Predicted at node two	38/43 (88.37%)	

[a]Indicates a statistically significant observation at 5% level.
[b]Indicates a statistically significant observation at the 10% level.

TABLE 4.   Comparison of Linear Probability and
Bivariate Probit Models

Parameter	$\beta_{\text{Bivariate Probit}}$	$\beta_{\text{Linear Probability}}$
Constant	-1.1852	-1.1875
P1	1.1547^{a}	0.89925^{b}
P2	0.8887^{b}	0.79925
P3	1.1451^{a}	0.9325^{a}
SPOT	-0.6032	-0.6275
ρ	0.9999	0.8668

[a]Indicates a statistically significant observation at 5% level.
[b]Indicates a statistically significant observation at the 10% level.

To compare the estimated coefficients in the probit and linear probability models, the slope coefficients in the linear probability model must be multiplied by 2.5. The constant term is also multiplied by 2.5, but then 1.25 is further subtracted from this product (Maddala, 1983). The results of the two models are very similar after making these adjustments (Table 4).

Larger volume shippers are more likely to contract directly with a carrier. The coefficient on VOLUME is statistically significant at the 5% significance level for both models and has the expected sign.

Product heterogeneity influences a shipper's decision at the second node. Shippers of heterogeneous foods (P4) are less likely to join a shippers' association than shippers of fresh produce (P3). To be sure, the difference between shippers of heterogeneous foods and the other shippers is not statistically significant at the 5% level for both models. However, the results are "suggestive," i.e., P1 and P2 have the expected sign and are significant at the 10% level for at least one model.[15]

There is insufficient evidence to argue that spot shippers are conditionally less likely to join a shippers' association. The coefficient on SPOT is insignificant at the 5 and 10% level. It has been argued that shippers' associations return to each member their Shapley Value. However, it is unclear whether this reward scheme also affects a shipper's probability of membership in an association.

The sample selection is also insignificant at the 5 and 10% level. Nonetheless, because our failure to reject the null hypothesis could be a Type II error, Greene's bivariate probit model with a correction for sample selection remains appropriate. On the one hand, the model is consistent (albeit inefficient) if $\rho = 0$.[16] On the other hand, failure to account for sample selection would make the model inconsistent if $\rho \neq 0$.

7. CONCLUSIONS

OSRA has been largely successful in promoting a more market-driven environment for determining freight rates based on private contracting between carriers and shippers.

[15]Because P1, P2, and P3 were not all significant for the linear probability model, the authors further estimated a model in which the explanatory variables included only SPOT and a dummy variable equal to the sum of P1, P2, and P3. The later dummy variable indicates the relationship between a shipper's decision at the second node and whether the shipper transports a relatively homogeneous commodity. For the linear probability model, the estimated coefficient on this variable was 0.3551, and it was significant at the 5% level (p-value $= 0.0224$).

[16]Personal correspondence with Dr. William Greene. Stern School of Business, New York University.

As a consequence, because freight rates and other logistical costs of using ocean liner services are now being determined in new ways, OSRA may have significant ramifications for the international competitiveness of the sectors that depend upon ocean shipping. This article investigates methods of transacting between agribusiness shippers and carriers to understand how these costs are determined. Not only do we find that rate-setting conferences will have less influence over ocean freight rates, but we find that agribusiness shippers are responding to OSRA's precipitation of more private contracting in two ways: direct negotiation with carriers, and through third-party agents. Large shippers are better suited to negotiate service contracts directly with carriers. However, small- and medium-sized shippers lack the quantity and freight volume needed to gain contract concessions from carriers. To acquire greater bargaining power, these shippers are increasingly turning to third-party agents to consolidate small shipments into larger, recurrent lots. The degree to which these shippers rely on the types of third party agents, freight forwarder, or shippers association, depends upon the relative benefits and costs of using each type. These costs and benefits are influenced by not only the quantity of the shipper's freight but also by the heterogeneity of the product and the freight rate.

8. ACKNOWLEDGMENTS

REFERENCES

Amemiya, T. (1975). Qualitative models. Annals of Economic and Social Measurement, 4, 363–372.

American Institute for Shippers' Associations. (2001). About shippers' associations. Washington, DC: American Institute For Shippers' Associations. URL: http://www.shippers.org.

Clyde, P., & Reitzes, J. (1998). Market power and collusion in the ocean shipping industry: Is a bigger cartel a better cartel. Economic Inquiry, 36, 292–304.

Federal Maritime Commission. (2001). The impact of the Ocean Shipping Reform Act of 1998. Washington, DC: The Commission, Washington. URL: http://www.fmc.gov.

Fox, N.R. (1994). An oligopoly model of ocean liner shipping. Review of Industrial Organization. 9, 343–355.

Fudenberg, D., & Tirole, J. (1993). Game theory. Cambridge, MA: MIT Press.

Greene, W.H. (1997). Econometric analysis (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.

Greene, W.H. (1998). Sample selection in credit-scoring models. Japan and the World Economy, 10, 299–316.

Maddala, G.S. (1983). Limited-dependent and qualitative variables in econometrics. Cambridge, UK: Cambridge University Press.

McGuire, M. (1972). Private good clubs and public good clubs: Economic models of group formation. Swedish Journal of Economics, 74, 84–89.

Neel, R., & Gooding, C. (1997). Service contracts, rate discounting, and the future of shipping conferences. International Advances in Economic Research, 3, 388–394.

Neel, R., Gooding, C., & Padgett, J. (1996). Proposed Ocean Shipping Reform Act's likely effects on conferences and rates. International Advances in Economic Research, 2, 477–483.

Sorenson, J.R., Tschirhart, J.T., & Whinston, A.B. (1978). Private good clubs and the core. Journal of Public Economics, 10, 77–95.

U.S. Department of Agriculture. (2001). Shipper and exporter assistance. Washington, DC: Agricultural Marketing Service. URL: http://www.ams.usda.gov/tmd/tmdsea.htm.

———————————————

Hayden G. Stewart *is an economist with the Economic Research Service, U.S. Department of Agriculture, Washington, DC. He received his PhD from Washington State University in 2001. His current research interests include the industrial organization of food markets.*

Fred S. Inaba *is an associate professor in the Department of Economics, Washington State University, Pullman, WA, where he teaches economic theory and industrial organization. He received his PhD from the University of California Berkeley in 1974. His current research interests include organization and contracting in transportation markets.*